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(54) **IMPACT RESISTANT FUSELAGE**

(57) The present invention belongs to the field of aircraft structures and aircraft protection against threat of high energy impacts, more particularly, to the field of impact resistant fuselage of an aircraft. The present invention discloses an impact resistant fuselage (6) of an aircraft, such impact resistant fuselage (6) comprising at least a ballistic material membrane (1) being located inside the aircraft fuselage (6).

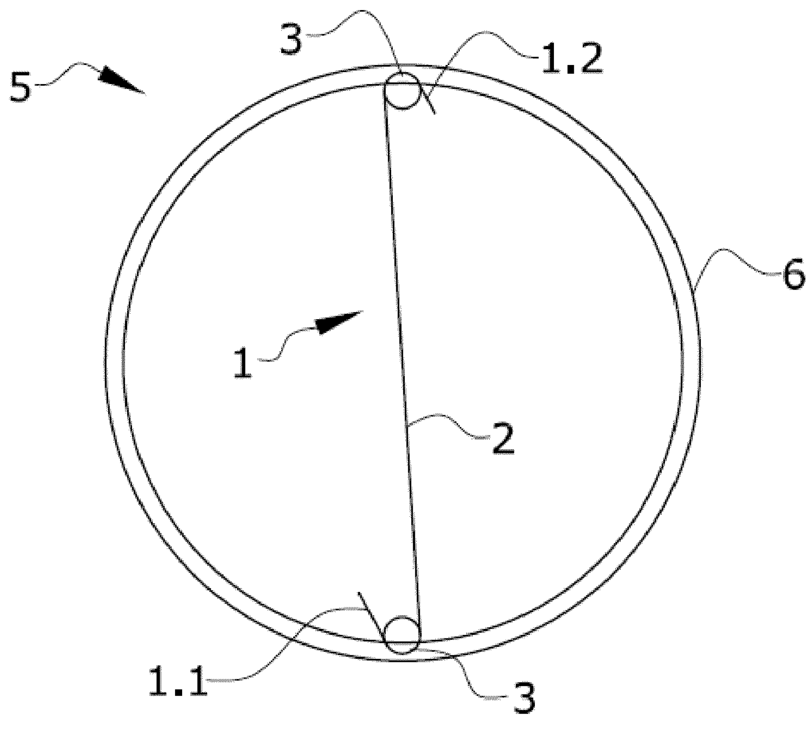

FIG.1

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention belongs to the field of aircraft structures and aircraft protection against threat of high energy impacts, more particularly, to the field of impact resistant fuselage of an aircraft.

[0002] The present invention discloses an impact resistant fuselage of an aircraft, such impact resistant fuselage comprising at least a ballistic material membrane being located inside the aircraft fuselage.

BACKGROUND OF THE INVENTION

[0003] There are known aircrafts equipped with engines configurations such as Open Rotor (OR) or Turbofan. In these aircrafts, potential hazardous events occurs such as a Propeller Blade Release (PBR) event, i.e. an event where an external blade of one engine comes off and hits the fuselage, or an Uncontained Engine Rotor Failure (UERF) event, i.e. an event where a part of the internal rotor of the engine breaks off, it is released and hits some aircraft structures, i.e. fuselage, vertical stabilizer, horizontal stabilizer..; generating large damages on said aircraft structures.

[0004] Although engine manufacturers are making efforts to reduce the probability of said failure events, experience shows that PBR and UERF events that can lead to catastrophic events continue to occur.

[0005] In terms of protection for UERF events, there are protections applied in order to minimize the hazards of an engine or Auxiliary Power Unit (APU) rotor failures. Additionally, a particular protection is applied on fuel tanks if they are located in impact areas, in order to minimize the possibility of fuel tank damage. The shielding of Aluminum or Titanium is typically used for these events.

[0006] As it is well known, weight is a fundamental aspect in the aeronautic industry and therefore there is a trend to use structures of a composite material instead of a metallic material even for primary structures such as fuselages. The usual composite materials made of carbon fibers, compared to conventional light weight metallic materials, presents a lower impact resistance due to lower out of plane properties and damage tolerance capabilities. Also, no plasticity behavior as on metallic materials is present in composite materials and they are not able to absorb high strain energy amounts when deforming.

[0007] Depending on the threat, the most widely spread ballistic composite armors are typically composed of layers of different materials, such as metal, fabrics and ceramics or by sole fabrics of materials with good ballistic performance, also called "dry" fabrics.

[0008] The unpressurized area of an aircraft is arranged at the back of an aircraft, and the fuselage housing that area is exposed to Propeller Blade Release (PBR) and Uncontained Engine Rotor Failure (UERF) events. Also, due that the APU is located in such unpressurized area of the aircraft, the fuselage of said area needs to be protected in order to minimize the risks of an impact damaging the fuselage structure and reaching the APU inside the aircraft.

[0009] Thus, there is a need for unpressurised fuselage structures able to satisfy the safety requirements and ballistic performance particularly when they are made up of composite materials.

SUMMARY OF THE INVENTION

[0010] The present invention provides an alternative solution for the aforementioned problems, by an impact resistant fuselage according to claim 1 and an aircraft according to claim 14. In dependent claims, preferred embodiments of the invention are defined.

[0011] In a first inventive aspect, the invention provides an Impact resistant fuselage of an aircraft, said fuselage being extended along a central longitudinal direction X-X', wherein transversal sections of the fuselage are comprised in a vertical plane V which is perpendicular to the central longitudinal direction X-X', the impact resistant fuselage comprises at least a ballistic material membrane extended along the longitudinal direction X-X' for absorbing high energy impacts, the at least ballistic material membrane according to a transversal section, comprises at least one section between two tensional elements, wherein

the at least ballistic material membrane is located inside the fuselage of the aircraft,

the at least one section of the ballistic material membrane is mechanically linked to the inside of the fuselage by the tensional elements, and

the two tensional elements stress the ballistic material membrane.

[0012] Throughout this entire document, "central longitudinal direction X-X'" will be understood as the direction that the longitudinal axis of an aircraft comprises passing through a central point of a section of the fuselage. That is, said central longitudinal direction X-X' will be understood as the direction from the aircraft tail's cone to the nose.

[0013] The vertical plane V is perpendicular to the central longitudinal direction X-X' in such a way that any transversal section of the aircraft fuselage is parallel to said vertical plane V.

[0014] In a particular embodiment, according to a transversal section of the present aircraft fuselage, the ballistic material membrane comprises at least one section between two tensional elements. Additionally, said at least one section of the ballistic material membrane is linked to the inside of the fuselage by the tensional elements, that is, said "section" will be understood as a part of the ballistic material membrane which is comprised between the tensional elements.

[0015] Throughout this entire document, "tensional elements" will be understood as mechanical elements which are in charge of keeping the ballistic material membrane tight between the at least one section of the ballistic material membrane. Thus, according to any embodiment of the present invention, these tensional elements contribute for ensuring the tensional state of the ballistic material membrane. Additionally, said tensional elements are in charge of mechanically linking the at least one section of such ballistic material membrane. Furthermore, throughout this document, "mechanically linked" will be understood as a mechanical connection between elements. Thus, in the present invention, the tensional elements are understood also as mechanical connection elements which links the ballistic material membrane to the inside of the aircraft fuselage.

[0016] Advantageously, the present ballistic material membrane installed inside the fuselage protects very efficiently an area of the aircraft in case of suffering an impact. Additionally, in case that the impact reaches the ballistic material membrane, part of the impact energy is absorbed by said ballistic material membrane thanks to its arrangement thus preventing that the impact reaches for instance relevant components or systems such as the APU among other components located inside the unpressurized area. Thus, the ballistic material membrane advantageously absorbs the impact energy thanks to the elastic deformation of such membrane, the resilience of the tensional element or thanks to both features.

[0017] In a particular embodiment, the impact resistant fuselage further comprises a plurality of ballistic material membranes extended along the longitudinal direction X-X' for absorbing high energy impacts, each ballistic material membrane according to a transversal section, comprises at least one section between two tensional elements. The plurality of ballistic material membranes is located inside the fuselage of the aircraft. The at least one section of each ballistic material membrane is mechanically linked to the inside of the fuselage by the tensional elements, wherein said tensional elements stress said ballistic material membrane. Also, the plurality of ballistic material membranes is arranged in a way free to contact each other.

[0018] In a more particular embodiment, the plurality of ballistic material membranes are arranged in such a way that each ballistic material membrane is parallel to each other.

[0019] Advantageously, the plurality of ballistic material membranes arranged inside the fuselage provides the possibility of protecting a plurality of zones/portions inside the fuselage. Additionally, the fact that said ballistic material membranes are extended in a way free to contact each other allows each membrane acts freely and independently to be able to absorb as much impact energy as possible in the most efficient way. Thus, each ballistic material membrane works independently, while the set of sections of each ballistic material membrane work together.

[0020] According to an embodiment, impact energy is absorbed by all segments in an elastic manner because the stress is being transmitted through the tensional elements; however, as each membrane acts freely and independently, the impact energy is directly transmitted to a first membrane, which may cause the tearing of its tensional elements, or said impact energy may be also transmitted to a second or even more membranes depending on the total energy of the impact.

[0021] In a particular embodiment, the tensional elements are end tensional elements which mechanically link the at least one section of the ballistic material membrane in a zone of the ballistic material membrane which is substantially closer to opposite ends of the ballistic material membrane. That is, according to preferred embodiments, a material membrane comprises one or more consecutive sections wherein two adjacent sections are being linked by means of at least one tensional element. This set of consecutive sections has two end sections, the first section and the last section, wherein each of said end sections has a free end where the end tensional element is located. As a result, the two end tensional elements are located at opposite end of the ballistic material membrane.

[0022] In a particular embodiment, the ballistic material membrane is provided extended along the longitudinal direction X-X' and, according to a transversal section, it comprises two opposite ends. In a more particular embodiment, the ballistic material membrane comprises at least a section arranged between such opposite ends of the ballistic material membrane. In another particular embodiment, the ballistic material membrane comprises a plurality of sections between the opposite ends of the ballistic material membrane.

[0023] The end tensional elements, in addition to keeping the ballistic material membrane, tight between its opposite ends or between the zone of the ballistic material membrane that is in contact with the inside of the fuselage by said end tensional elements, are also configured to link the ballistic material membrane in a way that, advantageously, in case of impact said end tensional elements supports the deformation of the membrane preventing it from breaking.

[0024] The fact that the ballistic material membrane is linked to the inside of the fuselage allows that said links are mechanical element whereby the ballistic material membrane is attached to inside the fuselage, and also said links can break or retain the ballistic material membrane attached to the inside of the fuselage.

[0025] In a particular embodiment, the end tensional elements are fixing supports which are joined to the inside of the fuselage, in such a way that said fixing supports fix the ballistic material membrane to the inside of the fuselage.

[0026] In a more particular embodiment, the tensional elements are joined to an inner structure of the aircraft fuselage.

[0027] The fixing supports, advantageously, allow maintaining the ballistic material membrane fixed inside the fuselage. In a more particular embodiment, such fixing supports fix the ballistic material membrane in its ends to the inner structure of the fuselage, i.e. frames, stringers, ribs, inner skin.

[0028] In another particular embodiment, the end tensional elements show resilience properties for instance comprising elastic deformable elements.

[0029] In another particular embodiment, the end tensional elements are tearable joints. In a more particular embodiment, such tearable joint joins the ballistic material membrane in its ends to the inner structure of the fuselage, i.e. frames, stringers, ribs, inner skin.

[0030] The tearable joint is a progressively tearable joint in such a way that, advantageously, said joint allows the ballistic material layer easily tears from the inner structure of the fuselage while absorbing energy from the impact. Additionally, in case of an impact occurs and the ballistic material membrane tears down the structural elements of the fuselage are not damaged.

[0031] In a more particular embodiment, the tearable joint is preferably a line of fuse rivets. Throughout this entire document, "fuse rivet" will be understood as a joint which comprises rivets or fasteners which are easy to tear if the ballistic material membrane does not supports the impact energy or the amount of energy to absorb is too high. In another embodiment the tearable joint is a bonded joint between the ballistic material membrane and the inner structure of the fuselage.

[0032] In a particular embodiment, the end tensional elements are rotating supports which are joined to the inside of the fuselage, such rotating supports comprise a sliding surface with which the ballistic material membrane is in contact in such a way that said ballistic material membrane is arranged in a sliding manner around the sliding surface, and the ballistic material membrane is fixed in its opposite ends to the inside of the fuselage.

[0033] Advantageously, the fact that the ballistic material membrane is fixed in its opposite ends to the inside of the fuselage allows that in case of an impact occurs, the ballistic material layer can slide on the sliding surface of the rotating supports.

[0034] In a particular embodiment, the impact resistant fuselage further comprises at least one intermediate tensional element providing a plurality of sections of the ballistic material membrane. Additionally, said at least one intermediate tensional element being located between a pair of consecutive sections of the ballistic material membrane such that said sections are arranged in a way free to contact each other.

[0035] The arrangement of such intermediate tensional elements, advantageously, allows each section of the ballistic material membrane be tight between them in such a way that thanks to said intermediate tensional elements and the end tensional elements the whole ballistic material membrane is tight between its opposite ends.

[0036] In a particular embodiment, the intermediate tensional elements are:

or rotating supports located between a pair of consecutive sections and joined to the inside of the fuselage, such rotating supports comprise a sliding surface with which the ballistic material membrane is in contact in such a way that said ballistic material membrane is arranged in a sliding manner around the sliding surface,

or fixing supports located between a pair of consecutive sections and joined to the inside of the fuselage, in such a way that said fixing supports fix each of the two fixed sections of the ballistic material membrane to the inside of the fuselage,

or tearable joints located between a pair of consecutive sections, preferably a line of fuse rivets, or

or any combination of them.

[0037] According to the arrangement of the ballistic material membrane around the sliding surface of the rotating support, if an impact occurs, it is generated friction due to the slippage of the ballistic material membrane around the sliding surface of said support. Thus, advantageously, said friction absorbs part of the impact energy. Furthermore, if an impact occurs, each section of the ballistic material membrane will progressively elastically deform in such a way that due to the stress transmitted from one section to another, advantageously, said elastic deformation of each section absorbs part of the impact energy.

[0038] In the particular embodiment wherein the ballistic material membrane is fixed to inside the fuselage by fixing supports, due that the ballistic material membrane is fixed to inside the fuselage between each section, if an impact occurs and a section is perforated, then the impact will achieve the following section and so on with the rest of the section. Thus, particularly the fixing provides a support between sections of the ballistic material membrane, advantageously, allows that if one of the sections is perforated absorbing part of the impact energy, the following section will keep the stress, resist the impact and absorb part of the impact energy by its elastic deformation.

[0039] In the particular embodiment wherein the end tensional elements or the intermediate tensional elements are tearable joints, due that the ballistic material membrane is joined by a line of fuse rivets to inside the fuselage between each section, if an impact occurs and a section does not support the impact energy and is teared, then the impact will achieve the following section and so on with the rest of the sections. Thus, particularly providing a line of fuse rivets between sections of the ballistic material membrane, advantageously, allows that if one of the sections is teared absorbing part of the impact energy, the following section will resist the impact and absorb the impact energy by its elastic deformation.

[0040] In another particular embodiment, the plurality of sections of the ballistic material membrane is arranged in such ways that such sections are parallel between them.

[0041] In a particular embodiment, the ballistic material membrane comprises at least two sections between the tensional elements in such a way that such tensional elements are intermediate tensional elements and the ballistic material membrane defines a closed space. In a more particular embodiment, the fuselage comprises a plurality of ballistic material membranes comprising at least two sections between the tensional elements in such a way that such tensional elements are intermediate tensional elements and each ballistic material membrane defined a closed space.

[0042] In another particular embodiment, the resistant fuselage further comprises at least one intermediate tensional element providing a plurality of sections of the ballistic material membrane, and said at least one intermediate tensional element being located between a pair of consecutive sections of the ballistic material membrane such that said sections are arranged in a way free to contact each other.

[0043] The arrangement of at least one ballistic material membrane defining a closed space inside the fuselage allows, advantageously, that substantially all the inside of the closed space is protected from impacts.

[0044] In a particular embodiment, the intermediate tensional elements are:

or rotating support located between a pair of consecutive sections (2) and joined to the inside of the fuselage (6), such rotating supports comprise a sliding surface (8) with which the ballistic material membrane (1) is in contact in such a way that said ballistic material membrane (1) is arranged in a sliding manner around the sliding surface (8),
or fixing support located between a pair of consecutive sections (2) and joined to the inside of the fuselage (6), in such a way that said fixing supports fix each of the two fixed sections (2) of the ballistic material membrane (1) to the inside of the fuselage (6),
or tearable joints located between a pair of consecutive sections (2), preferably a line of fuse rivets, or
or any combination of them.

[0045] In a particular embodiment, the ballistic material membrane is intended for receiving impacts. Thus, when an impact perforates the composite material of the fuselage and goes inside the fuselage, the ballistic material membrane is provided for receiving such impact, and advantageously, is configured to absorb part of the impact energy by its elastic deformation.

[0046] In a particular embodiment, the ballistic material membrane is arranged in unpressurized area of the aircraft.

[0047] In a second inventive aspect, the invention provides an aircraft comprising an impact resistant fuselage according to the first inventive aspect.

[0048] All the features described in this specification (including the claims, description and drawings) and/or all the steps of the described method can be combined in any combination, with the exception of combinations of such mutually exclusive features and/or steps.

DESCRIPTION OF THE DRAWINGS

[0049] These and other characteristics and advantages of the invention will become clearly understood in view of the detailed description of the invention which becomes apparent from a preferred embodiment of the invention, given just as an example and not being limited thereto, with reference to the drawings.

Figure 1 This figure shows a schematic view of a transversal section of an aircraft fuselage according to an embodiment of the present invention.

Figure 2 This figure shows a schematic view of a transversal section of an aircraft fuselage according to an embodiment of the present invention.

Figure 3 This figure shows a detail schematic view of an intermediate tensional element according to an embodiment of the present invention.

Figure 4 This figure shows a schematic view of a transversal section of an aircraft fuselage according to an embodiment of the present invention.

Figure 5 This figure shows a schematic view of a transversal section of an aircraft fuselage according to an embodiment of the present invention.

Figure 6 This figure shows a schematic view of a transversal section of an aircraft fuselage according to an embodiment of the present invention.

Figure 7 This figure shows an aircraft according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0050] Figures 1 to 2, and 4 to 6 show a schematic view of a transversal section (5) of a fuselage (6) of an aircraft (7), wherein such transversal section (5) is contained in a vertical plane V, said vertical plane V being perpendicular to a central longitudinal direction X-X' of the aircraft (7).

[0051] In figures 1 and 2, the fuselage (6) comprises a ballistic material membrane (1) for absorbing high energy impacts, which is located inside such fuselage (6). The ballistic material membrane (1) comprises a first opposite end (1.1) and a second opposite end (1.2) which are closer to a zone of the ballistic material membrane

(1) wherein said membrane (1) is linked to the inside of the fuselage (6). The mechanically links of the ballistic material membrane (1) to the inside of the fuselage (6) is provided by two end tensional elements (3). As it can be observed, in both figures 1 and 2 the end tensional elements are shown as schematic elements.

[0052] In a particular example, the ballistic material membrane (1) is linked to the inside of the fuselage (6) in such a way that the outermost section of the ballistic material membrane (1), that corresponds to the opposite ends (1.1, 1.2), is free of stress.

[0053] In figure 1, the ballistic material membrane (1) comprises one section (2) between two end tensional elements (3).

[0054] In figure 2, the present resistant fuselage (6) comprises two tensional elements (3) and two intermediate tensional elements (4) in such a way that said intermediate tensional elements (4) provide a plurality of sections (2). That is, the ballistic material membrane (1) comprises a first section (2a), a second section (2b) and a third section (2c) from the first opposite end (1.1) to the second opposite end (1.2). Each intermediate tensional element (4) is arranged between each pair of consecutive sections (2; 2a, 2b, 2c) of the ballistic material membrane (1). As it can be observed in figures 2, 3 and 4, the intermediate tensional elements (4) are shown as schematic elements. Such intermediate tensional elements (4) are configured to maintain the ballistic material membrane (1) also linked to the inside of the fuselage (6) between each pair of consecutive section (2) of said ballistic material membrane (1).

[0055] In a particular example, the intermediate tensional elements (4) are rotating supports which are joined to the inside of the fuselage (6) and configured to allow that the ballistic material membrane (1) slides around a sliding surface (8) of the rotating support (shown in figure 3).

[0056] Additionally, figure 3 shows a detail view of how a ballistic material membrane (1) is arranged around an intermediate tensional element (4) which is a rotating support. The rotating support having a sliding surface (8) over which the ballistic material membrane (1) slides.

[0057] According to figure 2, in another particular example, wherein the intermediate tensional elements (4) are fixing supports or tearable joint, in case that an impact occurs and penetrates the first section (2a), the rest of sections (2b, 2c) of the ballistic material membrane (1) maintain said ballistic material membrane (1) joined inside the fuselage (6) thanks to the intermediate tensional elements (4). Thus, when an impact element penetrates the first section (2a) of the ballistic material membrane (1) the present configuration of the intermediate tensional elements (4) allows that the consecutive section, in particular, the second section (2b) receives the impact element. And if the impact element also penetrates the second section (2b) of the ballistic material membrane (1), said ballistic material membrane (1) is adapted to resist to the impact and to absorb at least part of the energy. In such a way that when the impact element penetrates both first and second section (2a, 2b) of the ballistic material membrane (1), the third section (2c) will receive such impact. In this particular example, once the impact element penetrate the two first sections (2a, 2b) of the ballistic material membrane (1), part of the impact energy is absorbed by each section (2a, 2b) of the ballistic material membrane (1) which has been penetrated by the impact element. So that, the impact element will impact on the consecutive sections (2c) of the ballistic material membrane (1) with less energy than the energy with which the impact element has already impacted on the previously sections (2a, 2b).

[0058] In figure 4, the resistant fuselage (6) comprises in its inside two ballistic material membranes (1) for absorbing high energy impacts. Both ballistic material membranes (1) comprise a first opposite end (1.1) and a second opposite end (1.2), and both ballistic material membranes (1) comprise two end tensional elements in which the ballistic material membranes (1) are anchored inside the fuselage (6). The mechanically links of each ballistic material membranes (1) to the inside of the fuselage (6) are provided by two end tensional element (3) and two intermediate tensional elements.

[0059] In this embodiment, two ballistic material membranes (1) are arranged in a similar manner to that shown in figure 2 wherein the two ballistic material membranes (1) are located at a smaller arc of the fuselage thus maximizing the protected space at the center and reducing the length of each ballistic material (1). The exact location of the tensional elements (4) depends on engine debris trajectory.

[0060] Additionally, figure 4 shows each ballistic material membrane (1) comprising a plurality of sections (2) in the same way as shown in Figure 2. The intermediate tensional elements (4) of both ballistic material membranes (1) provide a first section (2a), a second section (2b) and a third section (2c) from the first opposite end (1.1) to the second opposite end (1.2) of the ballistic material membrane (1). Also, each intermediate tensional element (4) is arranged between each pair of consecutive sections (2; 2a, 2b, 2c) of each ballistic material membrane (1). The arrangement according to this embodiment allows protecting the inner space of the impact resistant fuselage (6) in two opposite sides effectively.

[0061] Figure 5 shows a resistant fuselage (6) of an aircraft, wherein the fuselage (6) comprises two ballistic material membranes (1) arranged parallel between them and also extended in a parallel way along the central longitudinal direction X-X'. Each ballistic material membrane (1) comprising two sections (2), each section (2) arranged between two tensional elements which are intermediate tensional elements (4), in such a way that each ballistic material membrane (1) defines a closed space.

[0062] Figure 6 shows a resistant fuselage (6) of an aircraft (7), wherein the fuselage (6) comprises four intermediate tensional elements (4) which provides four sections (2) of the ballistic material membrane (1).Each intermediate tensional element (4) is arranged between each pair of consecutive sections (2) of the ballistic material membrane (1) in such a way that the ballistic material membrane (1) defines a closed space.

[0063] Figure 7 shows an aircraft (7) according to the present invention which comprises a fuselage (6) with a ballistic material membrane (1) arranged inside said fuselage (6) (not shown).

Claims

1. Impact resistant fuselage (6) of an aircraft (7), said fuselage (6) being extended along a central longitudinal direction X-X', wherein transversal sections (5) of the fuselage (6) are comprised in a vertical plane V which is perpendicular to the central longitudinal direction X-X', the impact resistant fuselage (6) comprises at least a ballistic material membrane (1) extended along the longitudinal direction X-X' for absorbing high energy impacts, the at least ballistic material membrane (1) according to a transversal section (5), comprises at least one section (2) between two tensional elements, wherein the at least ballistic material membrane (1) is located inside the fuselage (6) of
the aircraft (7), the at least one section (2) of the ballistic material membrane (1) is
mechanically linked to the inside of the fuselage (6) by the tensional elements, and the two tensional elements stress the ballistic material membrane (1).

2. Impact resistant fuselage (6) according to claim 1, wherein it further comprises a plurality of ballistic material membranes (1) extended along the longitudinal direction X-X' for absorbing high energy impacts, each ballistic material membrane (1) according to a transversal section (5), comprises at least one section (2) between two tensional elements, wherein
the plurality of ballistic material membranes (1) is located inside the fuselage (6) of the aircraft (7),
at least one section (2) of each ballistic material membrane (1) is mechanically linked to the inside of the fuselage (6) by the tensional elements, wherein said tensional elements stress said ballistic material membrane (1), and
the plurality of ballistic material membranes (1) is arranged in a way free to contact each other.

3. Impact resistant fuselage (6) according to any of previous claims, wherein the tensional elements are end tensional elements (3) which mechanically link the at least one section (2) of the ballistic material membrane (1) in a zone of the ballistic material membrane (1) which is substantially closer to opposite ends (1.1, 1.2) of the ballistic material membrane (1).

4. Impact resistant fuselage (6) according to claim 3, wherein the end tensional elements (3) are fixing supports which are joined to the inside of the fuselage (6), in such a way that said fixing supports fix the ballistic material membrane (1) to the inside of the fuselage (6).

5. Impact resistant fuselage (6) according to claim 3, wherein the end tensional elements (3) are tearable joints, preferably a line of fuse rivets.

6. Impact resistant fuselage (6) according to claim 3, wherein
the end tensional elements (3) are rotating supports which are joined to the inside of the fuselage (6), such rotating supports comprise a sliding surface (8) with which the ballistic material membrane (1) is in contact in such a way that said ballistic material membrane (1) is arranged in a sliding manner around the sliding surface (8), and
the ballistic material membrane (1) is fixed in its opposite ends (1.1, 1.2) to the inside of the fuselage.

7. Impact resistant fuselage (6) according to any of previous claims, wherein
it further comprises at least one intermediate tensional element (4) providing a plurality of sections (2) of the ballistic material membrane (1), and
said at least one intermediate tensional element (4) being located between a pair of consecutive sections (2) of the ballistic material membrane (1) such that said sections (2) are arranged in a way free to contact each other.

8. Impact resistant fuselage (6) according to claim 7, wherein the intermediate tensional elements (4) are:

   or rotating supports located between a pair of consecutive sections (2) and joined to the inside of the fuselage (6), such rotating supports comprise a sliding surface (8) with which the ballistic material membrane (1) is in contact in such a way that said ballistic material membrane (1) is arranged in a sliding manner around the sliding surface (8),
   or fixing supports located between a pair of consecutive sections (2) and joined to the inside of the fuselage (6), in such a way that said fixing supports fix each of the two fixed sections (2) of the ballistic material membrane (1) to the inside of the fuselage (6),
   or tearable joints located between a pair of consecutive sections (2), preferably a line of fuse rivets, or
   or any combination of them.

9. Impact resistant fuselage (6) according to any of claims 7 to 8, wherein the plurality of sections (2) of

the ballistic material membrane (1) is arranged in such a way that such sections (2) are parallel between them.

10. Impact resistant fuselage (6) according to any of claims 1 to 2, wherein the ballistic material membrane (1) comprises at least two sections (2) between the tensional elements in such a way that such tensional elements are intermediate tensional elements (4) and the ballistic material membrane defines a closed space.

11. Impact resistant fuselage (6) according to claim 10, wherein
it further comprises at least one intermediate tensional element (4) providing a plurality of sections (2) of the ballistic material membrane (1), and
said at least one intermediate tensional element (4) being located between a pair of consecutive sections (2) of the ballistic material membrane (1) such that said sections (2) are arranged in a way free to contact each other.

12. Impact resistant fuselage (6) according to any of claims 10 to 11, wherein the intermediate tensional elements (4) are:

or rotating support located between a pair of consecutive sections (2) and joined to the inside of the fuselage (6), such rotating supports comprise a sliding surface (8) with which the ballistic material membrane (1) is in contact in such a way that said ballistic material membrane (1) is arranged in a sliding manner around the sliding surface (8),
or fixing support located between a pair of consecutive sections (2) and joined to the inside of the fuselage (6), in such a way that said fixing supports fix each of the two fixed sections (2) of the ballistic material membrane (1) to the inside of the fuselage (6),
or tearable joints located between a pair of consecutive sections (2), preferably a line of fuse rivets, or
or any combination of them.

13. Impact resistant fuselage (6) according to any of previous claims, wherein the ballistic material membrane (1) is intended for receiving impacts.

14. Aircraft (7) comprising an impact resistant fuselage (6) according to any of claims 1 to 13.

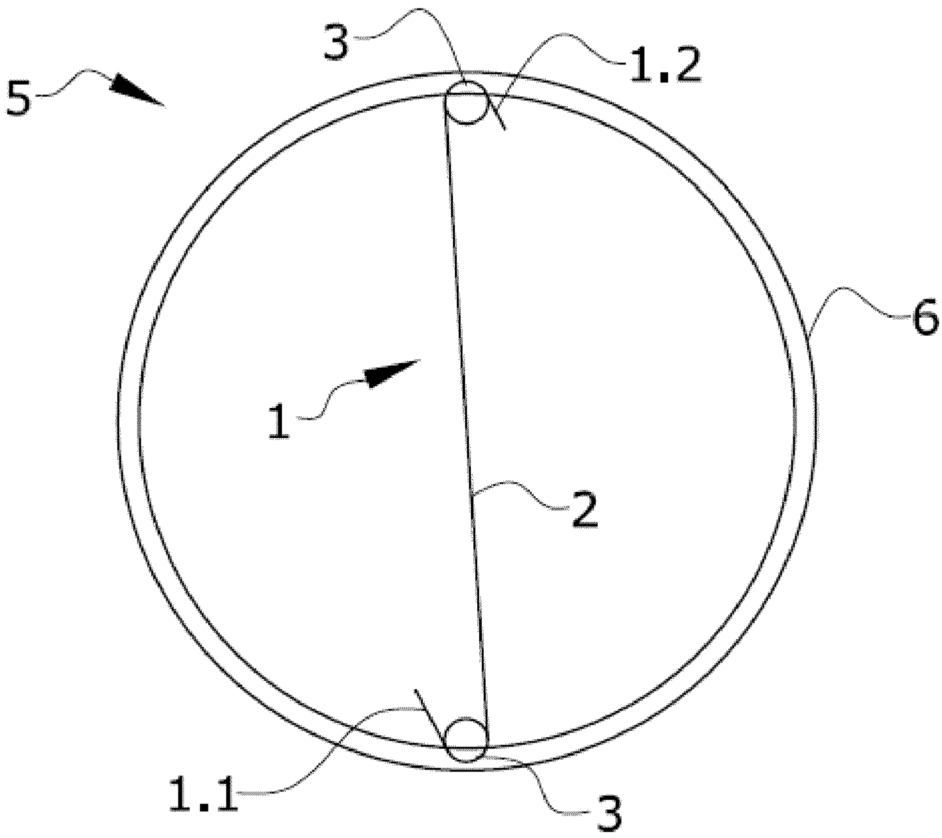

FIG.1

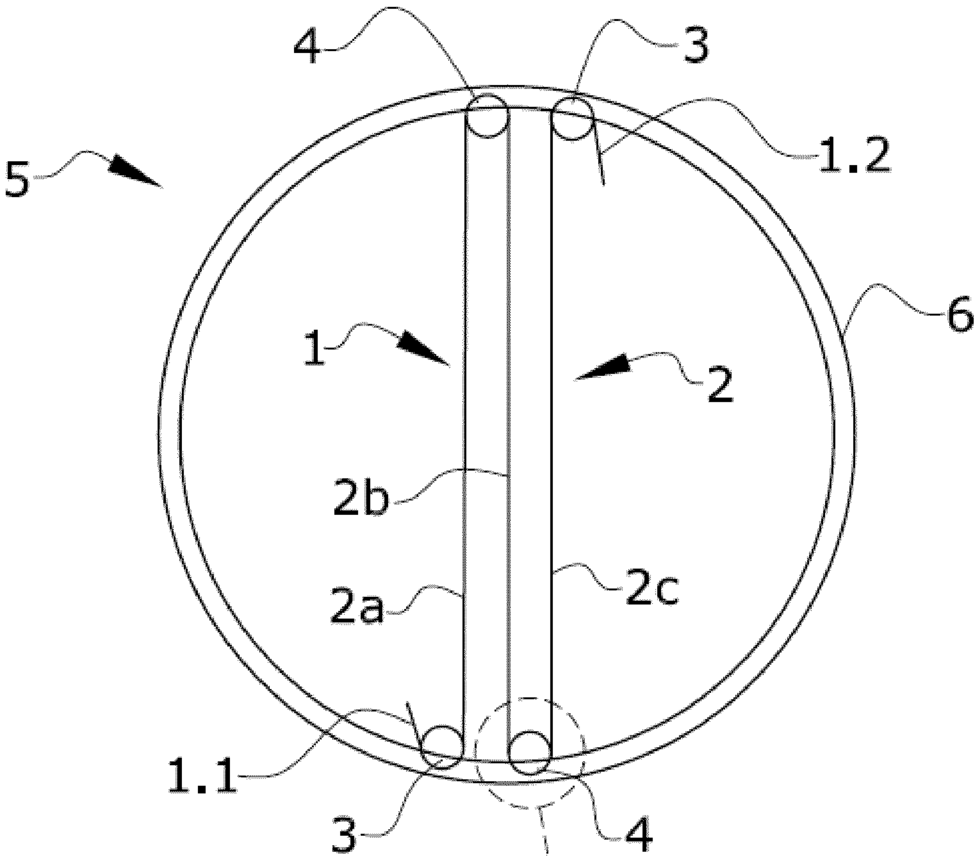

FIG.2

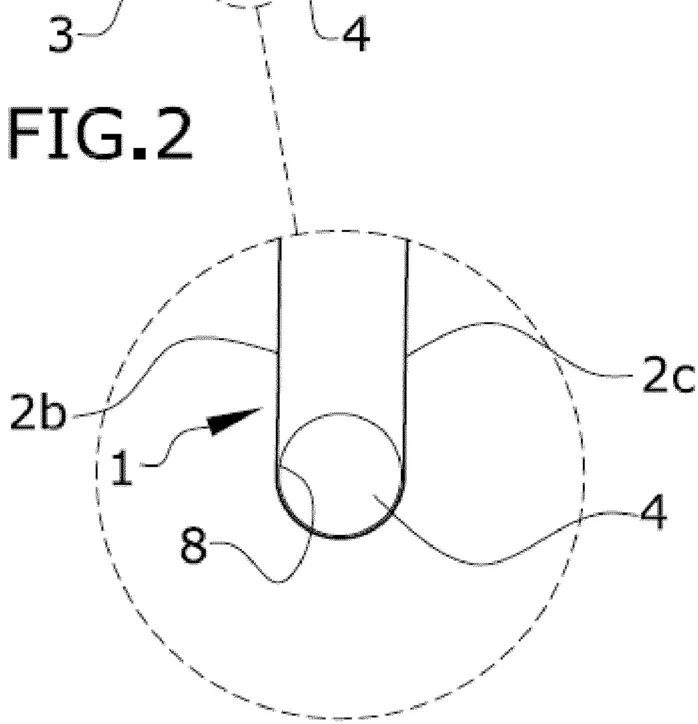

FIG.3

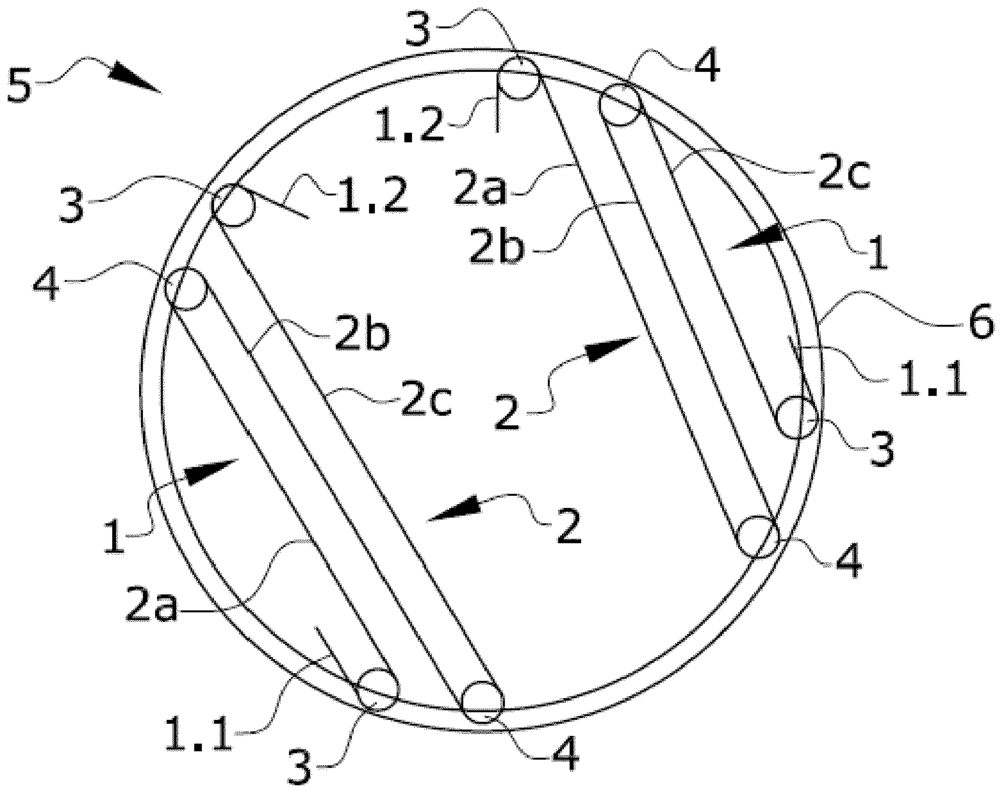

FIG.4

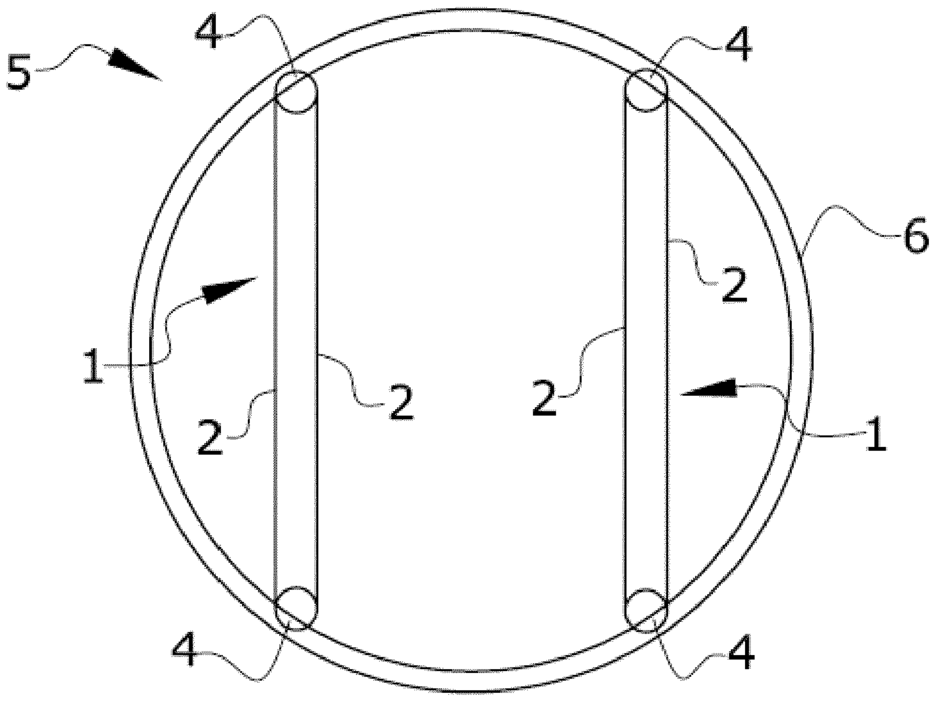

FIG.5

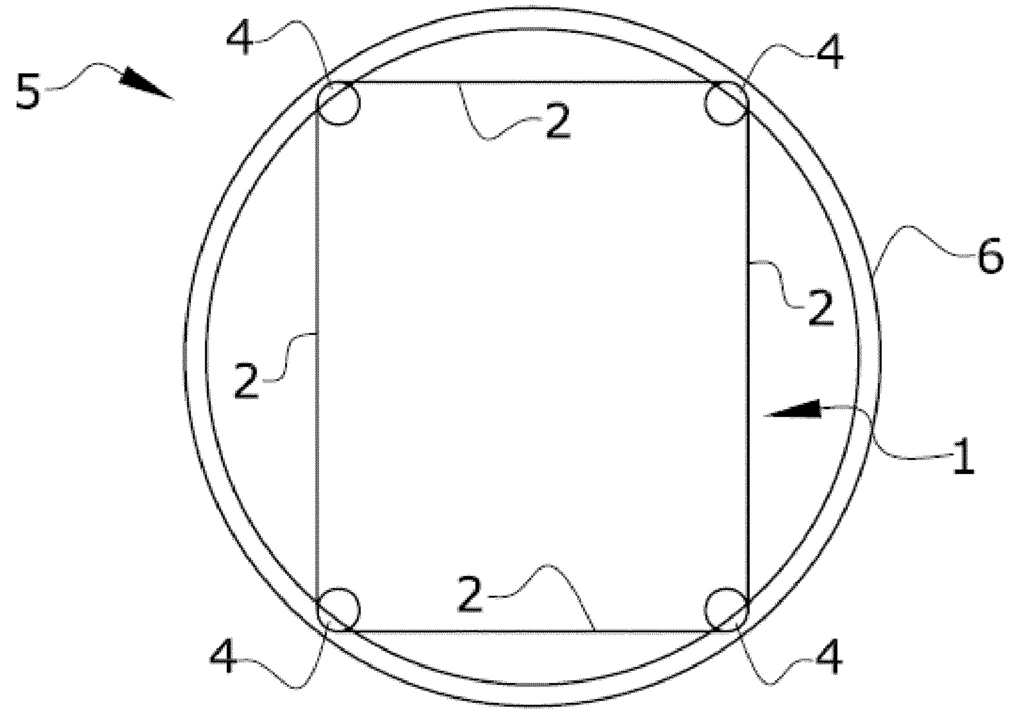

FIG.6

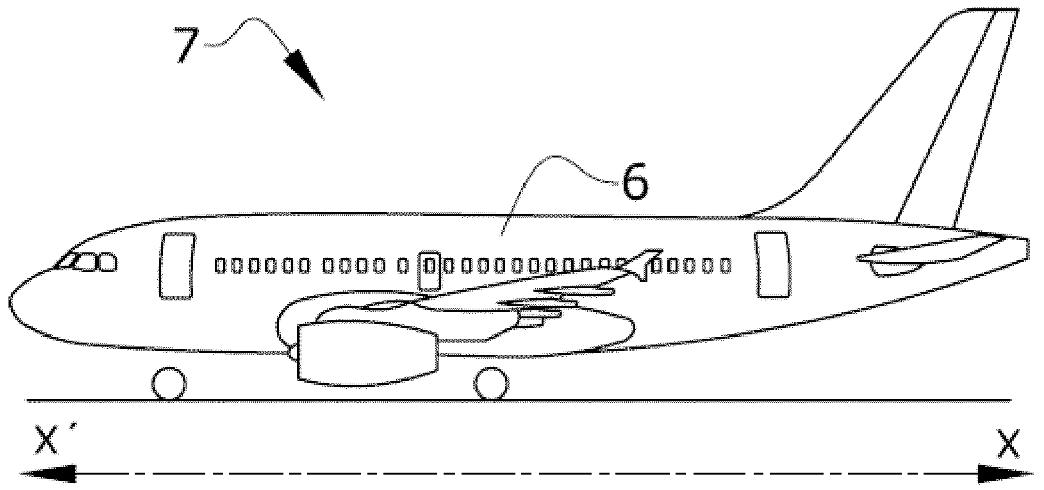

FIG.7

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EUROPEAN SEARCH REPORT

Application Number
EP 17 38 2132

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X	EP 2 514 671 A1 (AIRBUS OPERATIONS SL [ES]) 24 October 2012 (2012-10-24) * paragraphs [0022] - [0026]; figures 6-9 *	1-5,13, 14	INV. B64C1/06
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 May 2017	Lambert, Brice

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